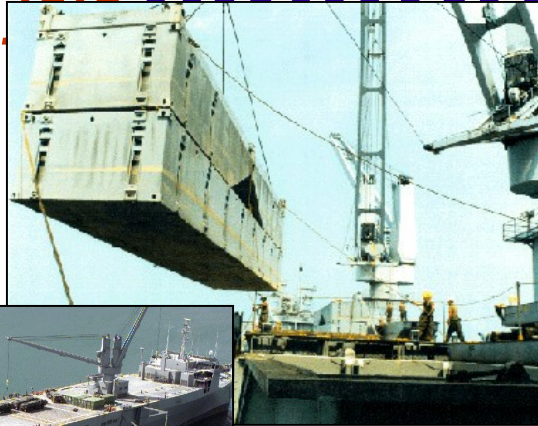


Coastal Throughput Modeling



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One Corps, One Regiment, One Team Serving Soldiers, the Army, and the Nation



Perspective

- **History**
 - **Former throughput models/shortfalls**
 - **Why develop CITM?**
- **Present**
 - **development timeline/current capabilities**
- **Future**
 - **Future uses of CITM class model**
 - **Development of small port models**



Methodologies for JLOTS M&S

In the 1990's there were several different models for throughput prediction and analysis

- **Linear algebra**
- **Virtual reality**
- **Integrated model concepts (time stepping)**

Force Projection - “a system of systems”

- **Very complex**
- **Very non-linear**
- **Extremely affected by environmental conditions**

CITM was developed (1998-2001) with RDT&E funding from the DoD as a time-domain tool to help provide accurate answers



Purpose

Tool to evaluate force projection capabilities when deep-draft ports are unavailable

- ◆ **Conventional JLOTS**

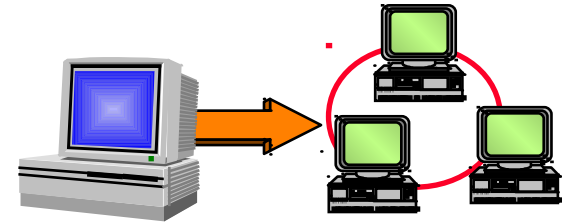
- ◆ **Lift-On/Lift-Off**
- ◆ **Roll-On/Roll-Off**

- ◆ **Emerging technologies**

- ◆ **Theater Support Vessel (TSV)**
- ◆ **Enhanced small ports**

- ◆ **Identification of limiting factors to throughput**

- ◆ **Objective site selection**



LOTS System Characteristics

- ***Nodes (ships, shore discharge)***
- ***Links (lighter types)***
- ***Experience (crew training levels)***
- ***Environment (sea state, bathymetry, tides, beach gradient)***
- ***Compatibility matrix (interoperability issues)***
- ***Operations (approach & moor, cast-off & clear, loading, unloading, traveling)***



```

graph TD
    A[Approach and Moor] -- 9 --> B[Load]
    B -- 8 --> C[Cast-off and Clear]
    C -- 4 --> D[Transit]
    D -- 4 --> E[Unload]
    E -- 8 --> F[Approach and Moor]
    D -- "Nearshore Bar?" --> A
  
```

The flowchart illustrates the operations of a ship, showing the sequence of activities and the number of times each activity is performed. The activities are arranged in a circular flow: Approach and Moor, Load, Cast-off and Clear, Transit, Unload, and Approach and Moor. The number of times each activity is performed is indicated by a blue circle with a white number: 9 for Approach and Moor, 8 for Load, 4 for Cast-off and Clear, 4 for Transit, and 8 for Unload. A red arrow labeled 'Nearshore Bar?' points from the 'Transit' activity to the 'Approach and Moor' activity.

$$t_{\text{total}} = \sum t_i + t_{\text{maint}} + t_{\text{fuel}}$$

Features of CITM

- ***PC Based***
- ***Fortran Code***
- ***Uses data from previous JLOTS operations***
- ***Allows re-positioning of ships and offload sites***
- ***Models current watercraft and off-load nodes***
- ***Incorporates ICODES input for ship manifest***
- ***1 minute time intervals***



• ***Cumulative/recent throughput output***



One Corps, One Regiment, One Team Serving Soldiers, the Army, the Navy, the Air Force, the Coast Guard, the Marine Corps, the Special Forces, the Civilian, the Nation

Features of CITM (cont.)

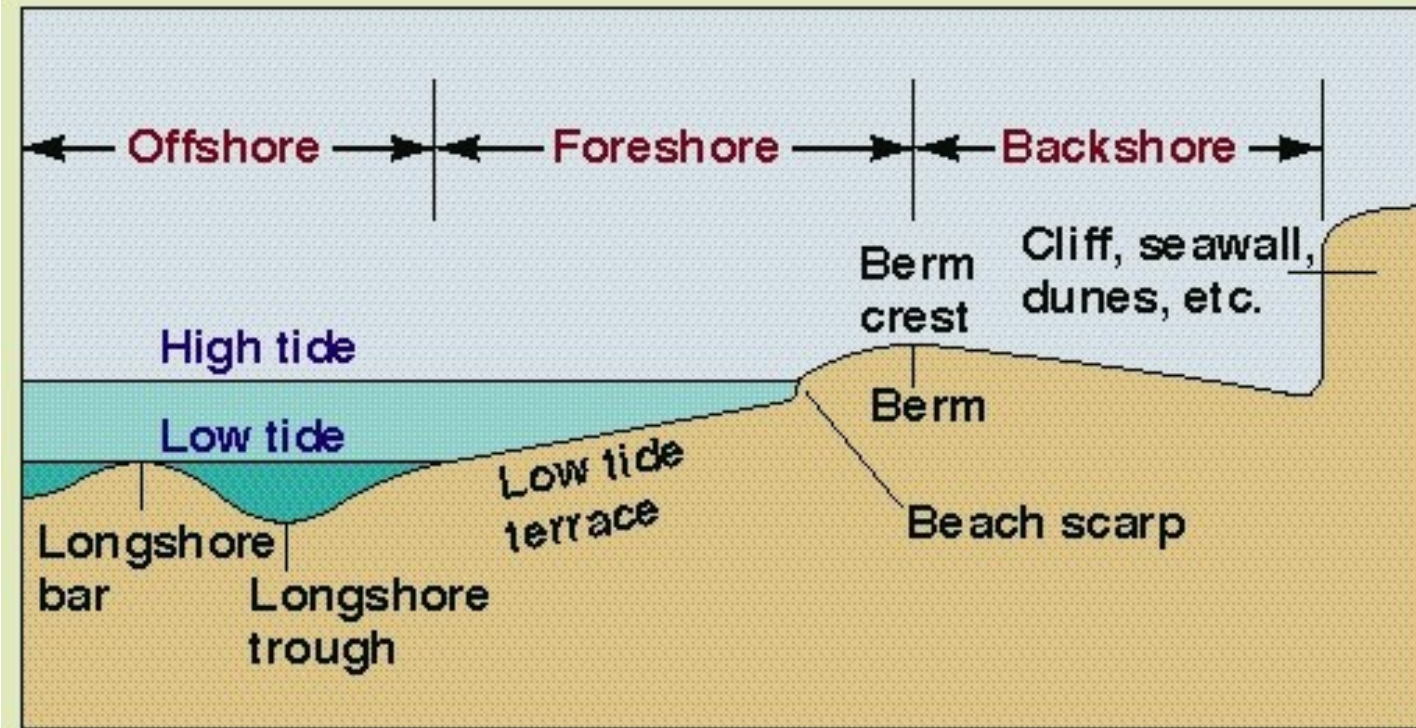
• Takes into account various factors that can affect throughput, to include the following:

- Seastate conditions***
- Bathymetry***
- Tide levels***
- Night operations***
- Crew experience levels***
- Ship/lighter/site compatibilities***
- Beach clearance capabilities***



Example of Nearshore Bathymetry:

A Typical Beach Profile



Test Case Scenario for Ft. Story and Eglin AFB

Offshore Nodes

- **1 Fast Sealift Ship (FSS)**
- **1 LMSR**

Onshore Nodes

- **1 ELCAS**
- **2 Bare Beach Sites (Splashpoints)**

Conditions

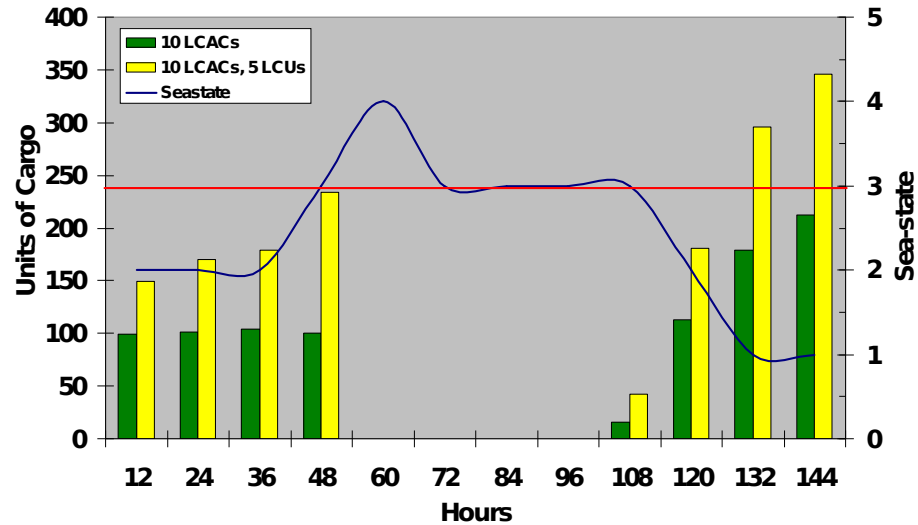
- **6 total days simulated**
- **Month of February**
- **RO/RO and LO/LO**

Environmental Data

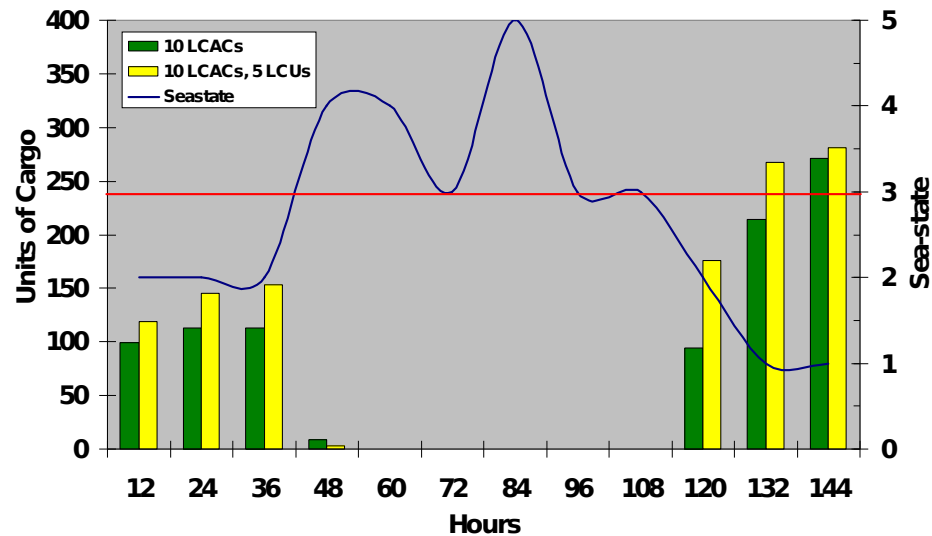
- **Bathymetry, 1/2 mile grid**
- **Wave Heights (historical)**
- **Tidal fluctuations (ADCIRC)**



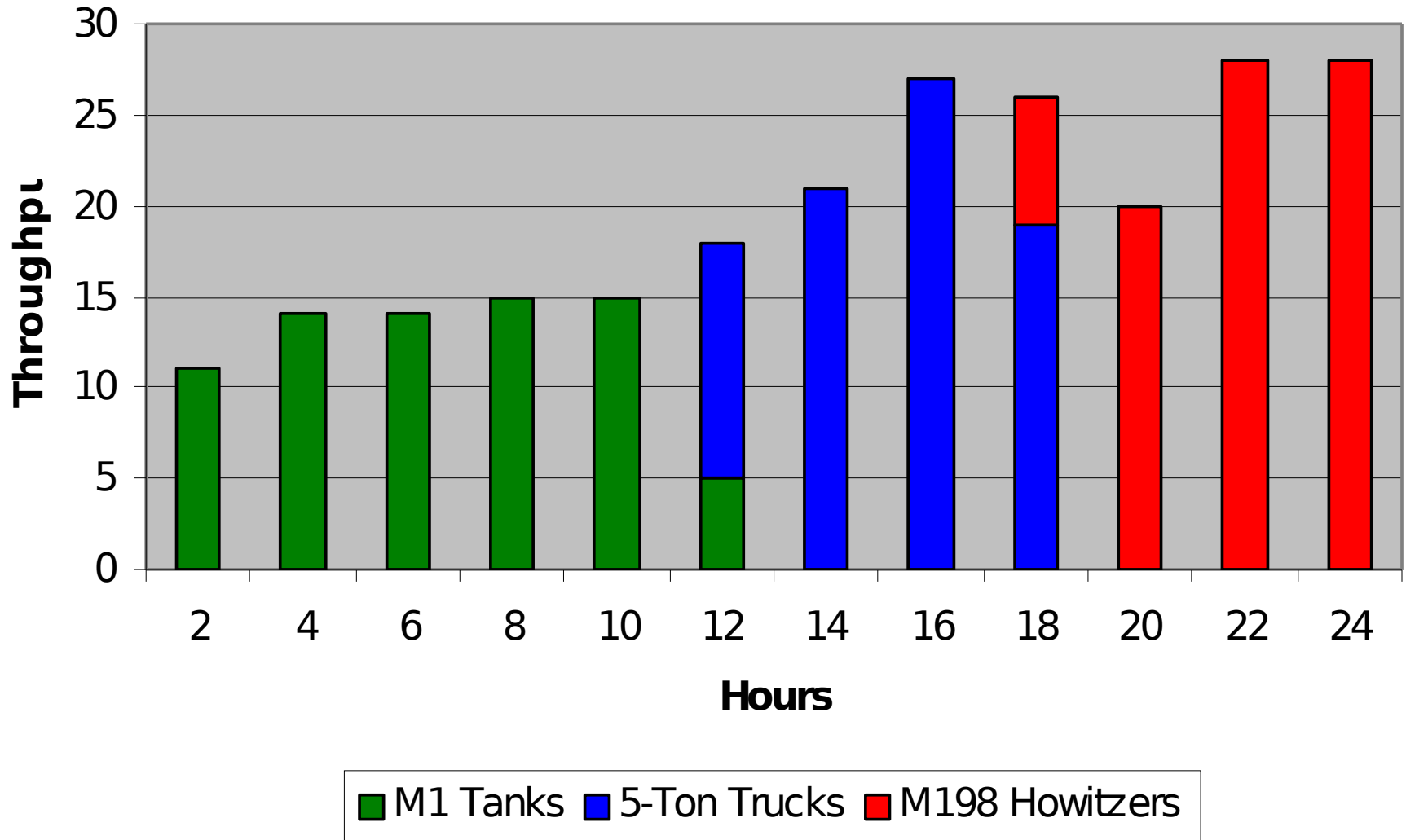
Ft. Story, VA



Eglin AFB, FL



Typical CITM Output Showing Prioritized



-
- A silhouette illustration of two men in business suits standing against a blue background with a white world map. The man on the left is pointing his right hand towards a location in Africa on the map. The man on the right is looking towards the same point. The map shows the continents in white against the blue background.



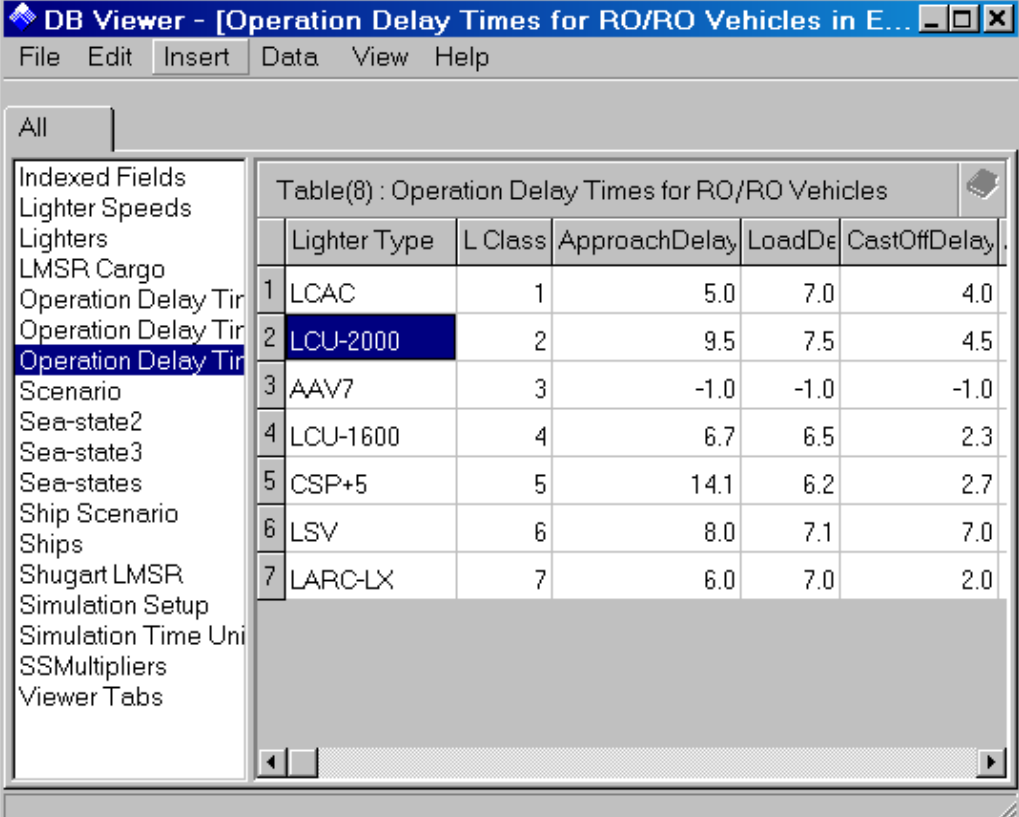
Converting CITM to Extend

- **Obstacles to overcome**
 - **Learning a new software language**
 - **CITM was written in Fortran**
 - **Needed to change from being a time-driven simulation to an event-driven simulation**
- **Advantages**
 - **Flowchart**
 - **Algorithms**
 - **Data**



Converting CITM to Extend

- **Screenshot of Database Viewer**
- **Includes:**
 - **Lighter characteristics**
 - **Ship characteristics**
 - **Sea-state data**
 - **Delay times for lighter operations**
 - **Ship's cargo**



The screenshot shows a database viewer window with a menu bar (File, Edit, Insert, Data, View, Help) and a list of indexed fields on the left. The main area displays a table titled 'Table(8) : Operation Delay Times for RO/RO Vehicles'. The table has six columns: Lighter Type, L Class, ApproachDelay, LoadDe, and CastOffDelay. The data is as follows:

	Lighter Type	L Class	ApproachDelay	LoadDe	CastOffDelay
1	LCAC	1	5.0	7.0	4.0
2	LCU-2000	2	9.5	7.5	4.5
3	AAV7	3	-1.0	-1.0	-1.0
4	LCU-1600	4	6.7	6.5	2.3
5	CSP+5	5	14.1	6.2	2.7
6	LSV	6	8.0	7.1	7.0
7	LARC-LX	7	6.0	7.0	2.0



Converting CITM to Extend

Notebook - ExtendCITM2Deb31.mox

Define Your Scenario

Select the type and quantity of lighters

LCU-2000	4
LSV	2
LCRC	5
CSP+5	1
None	0
None	0
None	0

Select the average experience level of the stevedore crews

Some Training, Some Experience

Enter the total number of ships in your scenario 2

Based on the table of ship configurations below, select each ship type

LMSR-1 = 1 RRDF w/2 offload points
1 crane offload point

LMSR-2 = 1 RRDF w/2 offload points
1 RRDF w/1 offload point
1 crane offload point

LMSR-3 = 1 RRDF w/2 offload points
2 crane offload points

LMSR-4 = 1 RRDF w/1 offload point
2 crane offload points

FSS-1 = 1 RRDF w/1 offload point
1 crane offload point

FSS-2 = 1 RRDF w/1 offload point
2 crane offload points

FSS-3 = 1 RRDF w/1 offload point
1 crane offload point

Enter the distance the ships are from shore (in miles) 1

Enter predominant Sea-State Conditions for your simulation run (1, 2 or 3) 2

Enter the total number of offload sites in your scenario 2

Select each type of offload site below

Floating Pier - 1 offload point

Bare Beach

None

None

None

Start Date & Time 2/8/2004 12:00 AM Sun

End Date & Time 2/10/2004 12:00 AM Tue

Click to turn animation off Animation off

Click to turn animation on Animation on

Done



Development of Future Modeling Tools for Force Projection

Capabilities must include

- throughput rate prediction
- site selection
- RPE impact assessment and tool selection



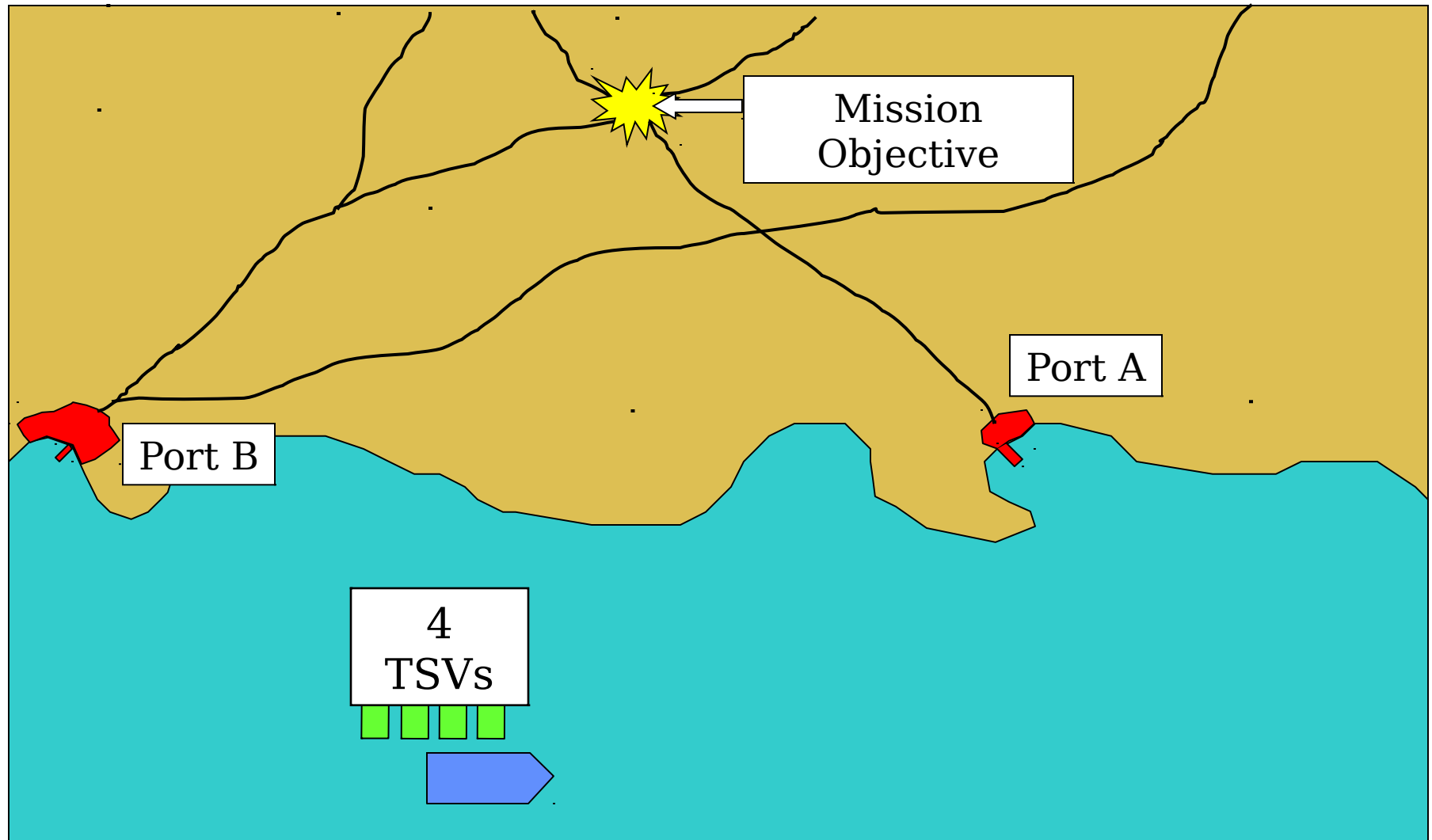
Future Force Projection From the Sea (Small Ports)

Three different aspects to site selection

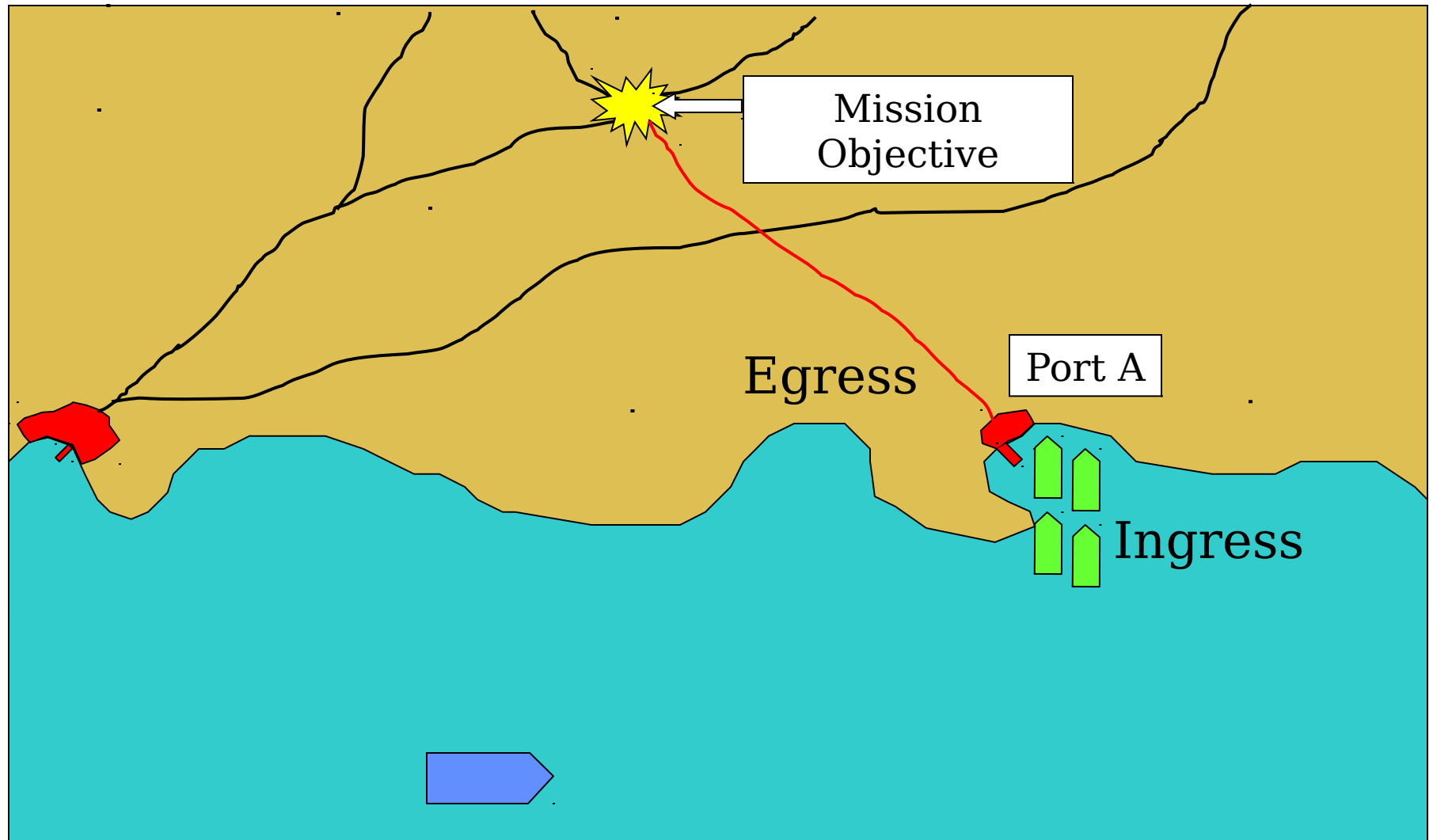
- throughput potential
- potential threat (bridges, tunnels, topography)
- maneuver advantage



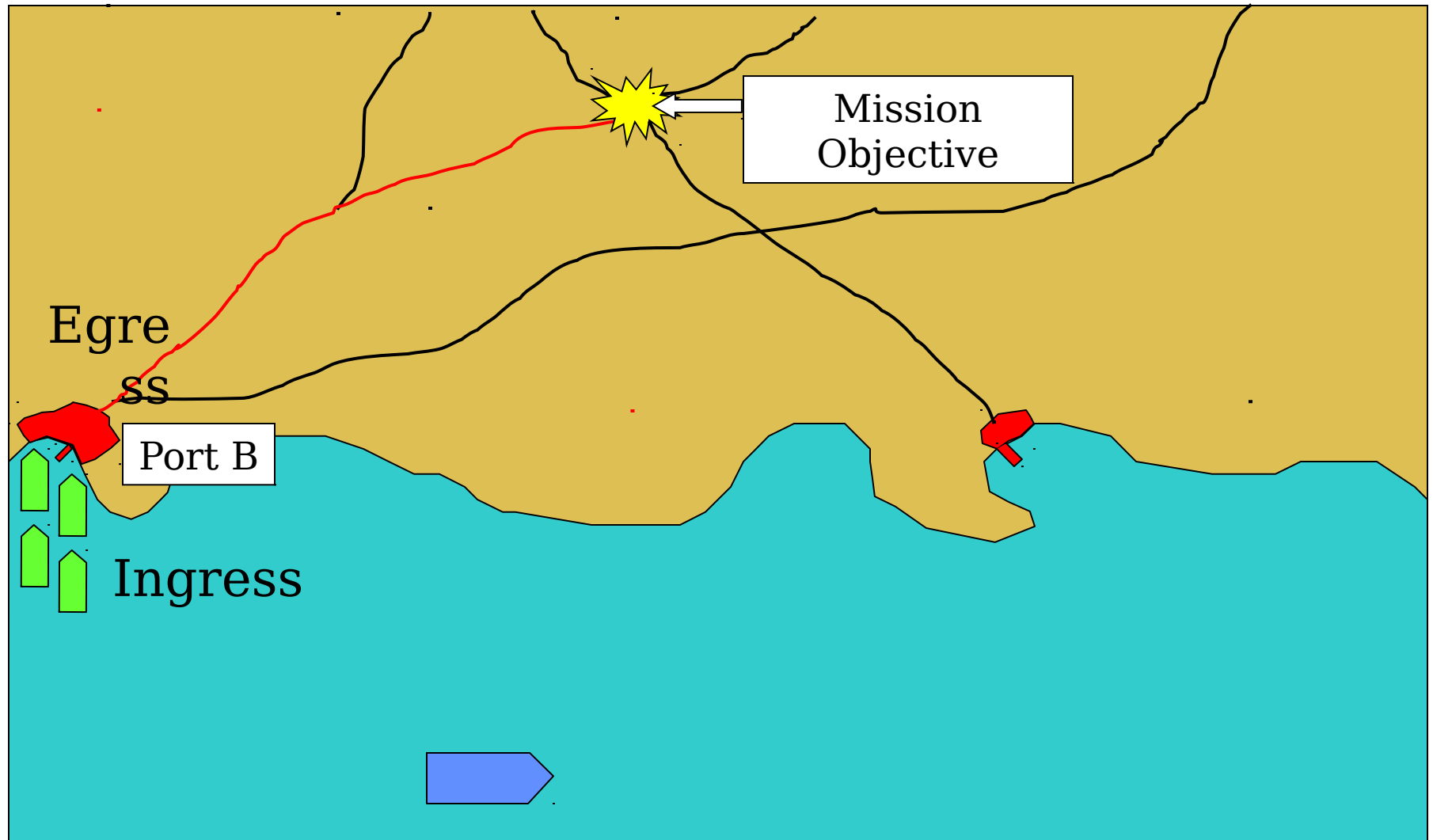
Example Scenario



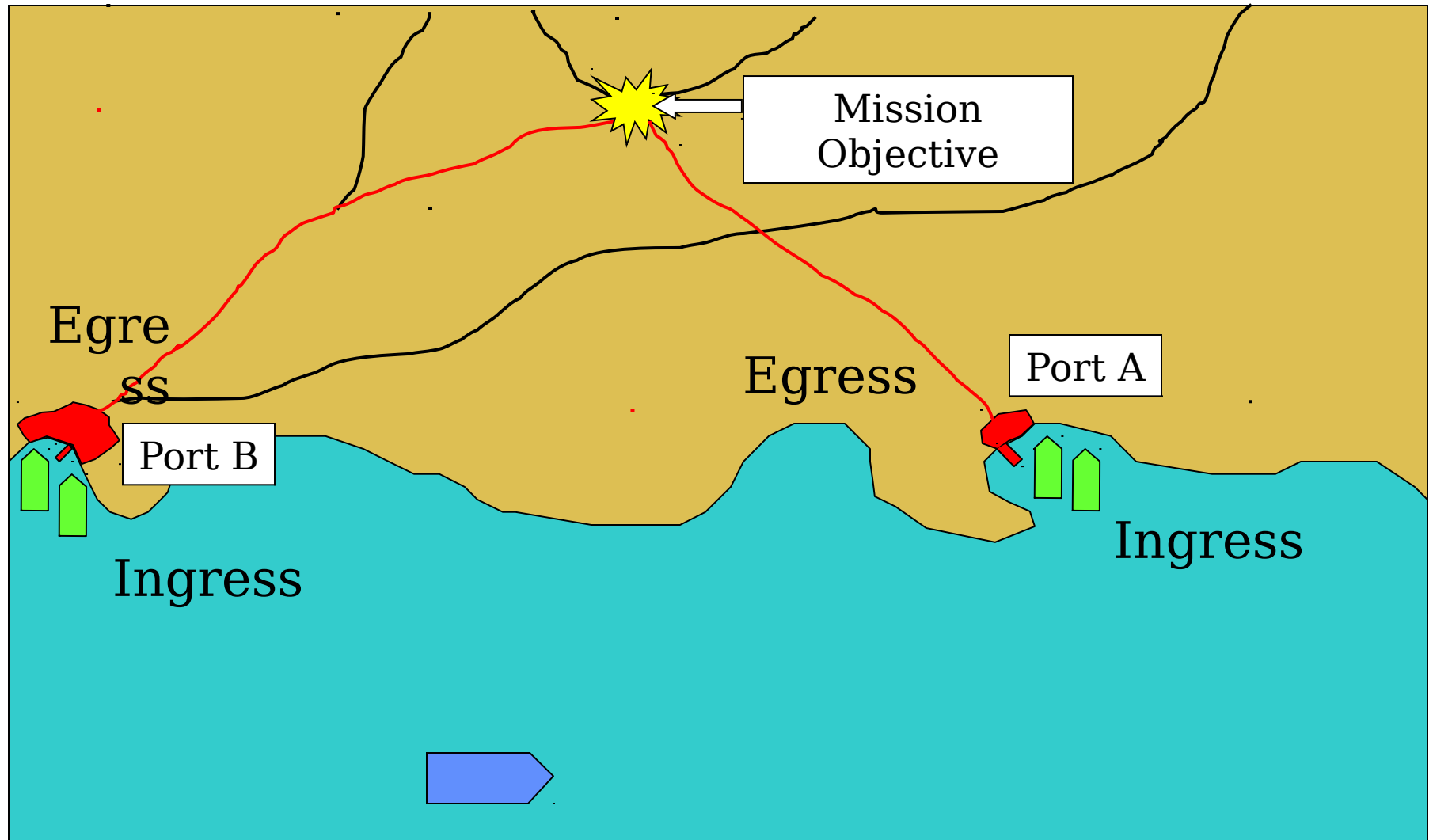
Scenario 1



Scenario 2



Scenario 3



A scenic photograph of a beach at sunset. Several palm trees are silhouetted against a sky with warm orange and yellow hues. In the foreground, a wooden boardwalk with stairs leads down to the sand. A few people are visible walking on the beach in the distance.

QUESTION(S)?